MICROELECTRONICS AND RELIABILITY

Editors-in-Chief

N. D. STOJADINOVIĆ **M. G. PECHT**

Founding Editor

G. W. A. DUMMER

VOLUME 37, 1997

VOLUME CONTENTS AND AUTHOR INDEX

PERGAMON

MICROELECTRONICS AND RELIABILITY

Editors-in-Chief

PROFESSOR N. D. STOJADINOVIĆ
Department of Microelectronics, Faculty of Electronic Engineering, University of Niš,
Beogradska 14, 18000 Niš, Yugoslavia
(Tel: +381 18 49-155; Fax: +381 18 46-180; E-mail: stojadinovic@efnis.elfak.ni.ac.yu)

PROFESSOR M. G. PECHT
CALCE Electronic Packaging Research Center, University of Maryland, College Park, MD 20742, U.S.A.
(Tel: +1 301 405-5323; Fax: +1 301 314-9269; E-mail: pecht@eng.umd.edu)

Regional Editors

S. C. SUN
Taiwan Semiconductor Manufacturing Co. Ltd
9 Creation Rd I
Science-Based Industrial Park
Hsinchu
Taiwan
Republic of China
(Tel: +886 35 781688 extn 4700; Fax: +886 35 773671;
E-mail: scsun@tmsc.co.tw)

H. IWAI
ULSI Device Engineering Laboratory
Microelectronics Engineering Laboratory
Toshiba Corporation
1 Komukai-Toshiba-cho, Saiwai-ku
Kawasaki 210
Japan
(Tel: +81 44 549 2335; Fax: +81 44 549 2291;
E-mail: iwai@ull.rdc.toshiba.co.jp)

F. FANTINI
Department of Information Technology
University of Parma
Viale delle Scienze, 43100, Parma
Italy
(Tel: +39 521 905 824; Fax: +39 521 905 822;
E-mail: fausto@ee.unipr.it)

D. PIERCE
Sandia Technologies Inc
PO Box 23338
Albuquerque, NM 87112
U.S.A.
(Tel/Fax: +1 505 271 0122;
E-mail: dpiercest@aol.com)

Editorial Advisory Board

H. S. Blanks, *Herzliya, Israel*
W. D. Brown, *Fayetteville, AK, U.S.A.*
S. Cristoloveanu, *Grenoble, France*
B. S. Dhillon, *Ottawa, Canada*
S. Dimitrijev, *Nathan, Brisbane, Australia*
D. M. Fleetwood, *Albuquerque, NM, U.S.A.*
M. Fukuda, *Kanagawa, Japan*
G. Groeseneken, *Leuven, Belgium*
P. Habas, *Vienna, Austria*
C. Hu, *Berkeley, CA, U.S.A.*
G. S. Hura, *Singapore*
R. M. Jacobs, *Livingston, NJ, U.S.A.*
B. Jenney, *Clayton, Melbourne, Australia*
B. K. Jones, *Lancaster, U.K.*
C. Ling, *Singapore*
A. Mathewson, *Cork, Ireland*
K. B. Misra, *Arunachal Pradesh, India*
S. Pershenkov, *Moscow, Russia*
M. K. Radhakrishnan, *Singapore*
S. S. Rao, *West Lafayette, IN, U.S.A.*
A. H. Rawicz, *Burnaby, Canada*
H. Reiche, *Ottawa, Canada*
J. L. Roca, *Buenos Aires, Argentina*
C. Singh, *College Station, TX, U.S.A.*
T. I. Sultan, *Giza, Egypt*
E. Takeda, *Tokyo, Japan*
A. Touboul, *Talence, France*
K. Verhaege, *Princeton, NJ, U.S.A.*
J. F. Verweij, *Enschede, The Netherlands*
H. Wong, *Kowloon, Hong Kong*

PUBLISHED MONTHLY

Publishing and Advertising Offices: Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, U.K.
(Tel: (01865) 843000; Fax: (01865) 843010)

Subscription rates: Annual Institutional Subscription Rates (1998): Europe, The CIS and Japan, 3436 Dutch Guilders. All other countries, U.S.$1975. Associated Personal Subscription Rates are available on request for those whose institutions are library subscribers. Dutch Guilder prices exclude VAT. Non-VAT registered customers in the European Community will be charged the appropriate VAT in addition to the price listed. Prices include postage and insurance and are subject to change without notice. For orders, claims, product enquiries (no manuscript enquiries) please contact the Customer Support Department at the Regional Sales Office nearest to you: **The Americas:** Elsevier Science Customer Support Department, PO Box 945, New York, NY 10010, U.S.A. [Tel: (+1) 212-633-3730/1-888 4ES-INFO. Fax: (+1) 212-633-3680. E-mail: usinfo-f@elsevier.com]. **Japan:** Elsevier Science Customer Support Department, 9-15 Higashi-Azabu 1-chome, Minato-ku, Tokyo 106, Japan [Tel: (+3) 5561-5033; Fax: (3) 5561-5047. E-mail: info@elsevier.co.jp]. **Asia Pacific (*excluding Japan*):** Elsevier Science (Singapore) Pte Ltd, No. 1 Temasek Avenue, 17-01 Millenia Tower, Singapore 039192 [Tel: (+65) 434-3727. Fax: (+65) 337-2230. E-mail: asiainfo@elsevier.com.sg]. **Rest of the World:** Elsevier Science Customer Service Department, PO Box 211, 1001 AE Amsterdam, The Netherlands [Tel: (+31) 20-485-3757. Fax: (+31) 20-485-3432. E-mail: nlinfo-f@elsevier.nl].

© 1998 Elsevier Science Ltd

Periodicals postage paid at Rahway, New Jersey and additional entry points. *Microelectronics and Reliability* (ISSN 0026-2714) is published 12 issues per year monthly, by Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, U.K. *Microelectronics and Reliability* is distributed by Mercury Airfreight International Ltd, 2323 Randolph Avenue, Avenel, NJ 07001-2413. POSTMASTER: Please send address corrections to *Microelectronics and Reliability*, c/o Elsevier Science Regional Sales Office, Customer Support Department, 655 Avenue of the Americas, New York, NY 10010, U.S.A.

VOLUME CONTENTS

Number 1

N. Stojadinović and M. Pecht	1	Editorial
		Review Papers
H. A. Schafft, D. L. Erhart and W. K. Gladden	3	Toward a building-in reliability approach
W. H. Krautschneider, A. Kohlhase and H. Terletzki	19	Scaling down and reliability problems of Gigabit CMOS circuits
S. Nakajima and T. Takeda	39	Failure analysis in halfmicron and quartermicron eras
		Research Papers
M. Minondo, J. Boussey and G. Kamarinos	53	The impact of the substrate preamorphisation on the electrical performances of p^+/n silicon junction diodes
P. Francis, J. P. Colinge and D. Flandre	61	Comparison of self-heating effect in GAA and SOI MOSFETs
C. Ciofi and S. Di Pascoli	77	Temperature coefficient of resistance fluctuations during electromigration in Al lines
L. K. J. Vandamme and A. J. van Kemenade	87	Resistance noise measurement: a better diagnostic tool to detect stress and current induced degradation
S. Graffi, G. Masetti and A. Piovaccari	95	Criteria to reduce failures induced from conveyed electromagnetic interferences on CMOS operational amplifiers
B. Lisenker and Y. Nevo	115	CMOS VLSI reliability test model
T. C. Garyet and N. Dickson	121	Improved understanding of physical defect mechanisms using fault simulation
P. M. Petković, D. P. Milovanović and V. B. Litovski	137	Symbolic fault modelling of MOS combinational circuits
		Technical Notes
E. V. Jelenkovic and K. Y. Tong	159	Effect of deposition conditions on stability of sputtered oxide in MOS structures
Deren Lu and Baoqing Li	171	Observation of DC currents induced in MOS capacitors during NBTS aging
J.-L. Loheac, F. Raoult, O. Bonnaud and M. Taurin	179	Analysis for the reliability of the intrinsic base ion implantation of a 3 GHz I^2L bipolar process from the measure of integrated resistances: from the results, setting of rules for an expert system

Number 2

Hongzhou Wang and Hoang Pham	187	Survey of reliability and availability evaluation of complex networks using Monte Carlo techniques
B. S. Dhillon and A. R. M. Fashandi	211	Robotic systems probabilistic analysis
K. Thirusangu and K. Rangarajan	225	Marked graphs and Euler graphs
Li Jianping and Jia Xishen	237	A new partial bound enumeration technique for solving reliability redundancy optimization
S. V. Gurov, S. P. Habarov and L. V. Utkin	243	Safety analysis of a multi-phased control system

J. Malinowski and W. Preuss	255	A parallel algorithm evaluating the reliability of a system with known minimal cuts (paths)
A. Aissani	267	Limit distributions for dependent thinning of dissipative point processes
A. N. Ahmed, A. A. Soliman and S. E. Khider	277	Preservation results for ordered random variables, with applications to reliability theory
R. C. Suich	289	Reliability and cost: questions for the engineer
T.-L. Tran, J. S. Sherif, C. Mikulski and M. Wang	297	MY-STAR: a methodology and system for tracing and analyzing requirements
A. A. Abdel-Ghaly, G. R. Al-Dayian and F. H. Al-Kashkari	305	The use of Burr type XII distribution on software reliability growth modelling
Ying Hui Tang	315	A single-server M/G/1 queueing system subject to breakdowns—some reliability and queueing problems
A. F. Attia	323	Estimation of the reliability function using the delay-time models
G. S. Mokaddis, M. L. Tawfek and S. A. M. Elhssia	329	Analysis of a two-dissimilar unit cold standby redundant system subject to inspection and random change in units
G. S. Mokaddis, M. L. Tawfek and S. A. M. Elhssia	335	Cost analysis of a two dissimilar-unit cold standby redundant system subject to inspection and two types of repair
A. A. Hagin	341	Reliability evaluation of a repairable network with limited capacity and structural redundancy
M. M. El Fahham and H. S. El Said	349	Asymptotic expansion in the limit theorem for the convergence to Laplace distribution
A. I. Shawky	355	The single-server machine interference model with balking, reneging and an additional server for longer queues
		Technical Notes
Jun Cai and Yanhong Wu	359	A note on the preservation of the NBUC class under formation of parallel systems with dissimilar components
D. Roy	361	On classifications of multivariate life distributions in the discrete setup
	367	Book reviews
	371	Calls for papers
	377	Calendar of international conferences, symposia, lectures and meetings of interest
	379	Erratum

Number 3

J. Fung and V. Makis	381	An inspection model with generally distributed restoration and repair times
H. Arsham	391	Goal-seeking problem in discrete event systems simulation
R. J. Burns	397	A simple technique for obtaining the MTBF of complex systems through numerical integration of the reliability function
W. G. Schneeweiss	403	Advanced hand calculations for fault tree analysis and synthesis
J. S. Dagpunar	417	The effect of minimal repairs on economic lot-sizing
J. N. Pan and S. L. Wu	421	Process capability analysis for non-normal relay test data
In-Kyeong Choi, Jai-Sang Koh and So-Yeon Lee	429	A symbolic reliability of multiple path required system with three states

D. Fakinos	437	The symmetric M/G/k loss system with heterogeneous servers
J. N. Pan	439	Reliability prediction of imperfect switching systems subject to multiple stresses
H.-Z. Huang	447	Fuzzy multi-objective optimization decision-making of reliability of series system
Cheng Kan and Wang Wen Yi	451	Preservation of some partial orderings under non-homogeneous Poisson shock model and Laplace transform
Seung Min Lee and Dong Ho Park	457	A test for the BMRL-t_0 class
Wenyi Wang and Hongfen Zhang	461	The methods of reduction in network reliability computing
Myung B. Kong and Kyung S. Park	467	Optimal replacement of an item subject to cumulative damage under periodic inspections
P. Cappelletti, R. Bez, D. Cantarelli, D. Nahmad and L. Ravazzi	473	CAST: an electrical stress test to monitor single bit failures in flash-EEPROM structures
J. M. Nahman	483	Enumeration of minimal cuts of modified networks
D. Wilkie, R. Drwinga, E. Eichman, N. Kunnari, B. Negley and D. Richardson	487	A design of experiment analysis of serial EEPROM endurance
G. S. Mokaddis, M. L. Tawfek and S. A. M. Elhssia	493	Some characteristics of a man–machine system operating subject to different weather conditions
Yeh Lam	497	A maintenance model for two-unit redundant system
B. S. Dhillon and N. Yang	505	Comparisons of block diagram and Markov method system reliability and mean time to failure results for constant and non-constant unit failure rates
Lian-Chang Zhao and Fan-Jia Kong	511	A new formula and an algorithm for reliability analysis of networks
M. K. Radhakrishnan	519	Die attach failures related to wafer back metal processing—an AES study
E. J. Vanderperre, S. S. Makhanov and S. Suchatvejapoom	525	Long-run availability of a repairable parallel system
	529	World abstracts on microelectronics and reliability
	547	Book review

Number 4

T. Yanagisawa	549	Estimation of the degradation of amorphous silicon solar cells
H. Reiche	555	A reliability study of a small vehicle
B. S. Dhillon and N. Yang	557	Formulas for analyzing a redundant robot configuration with a built-in safety system
M. Raghavachari, A. Srinivasan and P. Sullo	565	Poisson mixture yield models for integrated circuits: a critical review
K. W. Philp and N. D. Deans	581	Comparative redundancy, an alternative to triple modular redundant system design
U. D. Kumar and M. N. Gopalan	587	Analysis of consecutive k-out-of-n: F systems with single repair facility
Fang-Ming Shao and Lian-Chang Zhao	591	Optimal design improving a communication network reliability
M. V. Koutras	597	Consecutive-k,r-out-of-n: DFM systems

M. A. El-Damcese	605	System reliability with common-cause hazard to obey an exponential power model
M. T. Abuelma'atti and I. S. Qambar	609	SPICE application in the study of the behaviour of multi-state systems described by Markov models
Yeh Lam	615	An optimal maintenance model using a number of different actions
M. A. W. Mahmoud and M. E. Moshref	623	Probabilistic analysis of a two-unit cold standby redundant system subject to failure of controlled weather device
Lian-Chang Zhao and Fang-Ming Shao	629	Optimization of connecting two communication networks subject to a reliability constraint
Yi-Chih Hsieh	635	Optimal assignment of priorities for the machine interference problems
G. S. Mokaddis, S. W. Labib and A. M. Ahmed	641	Analysis of a two-unit warm standby system subject to degradation
A. Bouhdada, S. Bakkali and A. Touhami	649	Modelling of gate-induced drain leakage in relation to technological parameters and temperature
Jae-Hak Lim and Jai-Sang Koh	653	Reliability analysis and comparison of several structures
		Technical Notes
V. Ramachandran, V. Sivakumar, K. Sathiyanarayanan and S. Chandrasekaran	661	Genetics based redundancy optimization
V. Ramachandran, J. Kannan, K. Sathiyanarayanan and V. Sivakumar	665	Optimal replacement strategies—genetic algorithms approach
V. Sridharan and P. Mohanavadivu	669	Optimum interchangement time for a two-dissimilar-unit with two types of repairman
S. Dey and P. Sarmah	673	Estimation of parameters of a model of a complex repairable system
A. Rekha and T. Shyam Sunder	677	Survival function of a component under random strength attenuation
A. Rekha and T. Shyam Sunder	683	Reliability of a cascade system with exponential strength and gamma stress
	687	World abstracts on microelectronics and reliability
H. Reiche	711	Things are changing—a report on the Reliability and Maintainability Symposium 1996

Number 5

T. Puritis	713	Problems related to the avalanche and secondary breakdown of silicon p–n junction
O. Chryssaphinou, S. Papastavridis and T. Tsapelas	721	A generalized multi-standby multi-failure mode system with various repair facilities
Sung-Jae Cho and Kyung-Chang Kim	725	Recovery technique in a client–server main memory DB environment
N. P. Padhy, S. R. Paranjothi and V. Ramachandran	733	A hybrid fuzzy neural network-expert system for a short term unit commitment problem
E. J. Vanderperre, S. Vannakrairojn and S. S. Makhanov	739	A delay-differential equation related to a renewable parallel system
V. Sridharan and P. R. Jayashree	743	Transient behaviour for a continuous time parameter system with finite waiting room

V. Sridharan and P. Mohanavadivu	747	Reliability and availability analysis for two non-identical unit parallel systems with common cause failures and human errors
A. A. Ismaeel and R. Bhatnagar	753	Power-constrained testing for bridging and stuck short faults in CMOS combinational circuits
A. A. Ismaeel, R. Bhatnagar and M. Khan	763	Modeling for bridging faults in nMOS combinational circuits
L. V. Utkin, S. V. Gurov and I. B. Shubinsky	779	Reliability of systems by mixture forms of uncertainty
V. N. Rayapati and B. Kaminska	785	Dynamic reconfiguration schemes for megabit BiCMOS SRAMs and performance evaluation
N. Arora and D. Kumar	795	Availability analysis of steam and power generation systems in the thermal power plant
S. V. Gurov and L. V. Utkin	801	Reliability and optimization of systems with periodic modifications in the probability and possibility contexts
		Technical Notes
M. A. Aziz	809	Pathset enumeration of directed graphs by the set theoretic method
A. Chaturvedi	815	A note on sequential point estimation of the mean of a gamma population
N. Arora and D. Kumar	819	Stochastic analysis and maintenance planning of the ash handling system in the thermal power plant
B. N. Pandey and O. Rai	825	Shrinkage testimation of the shape parameter of an inverse Gaussian distribution using a $(\alpha\beta)_{min}$ test
S. P. Rajamanickam and B. Chandrasekar	829	Reliability measures for two-unit systems with a dependent structure for failure and repair times
V. Sridharan and P. Mohanavadivu	835	A note on the cost analysis of an n-unit system with spares
S. A. H. Rizvi and R. K. Singh	841	On estimation of population mean using known coefficient of variation
R. Gupta, S. Z. Mumtaz and R. Goel	845	A two dissimilar unit multi-component system with correlated failures and repairs
R. Gupta, Ramkishan and R. Goel	851	Analysis of a system having super-priority, priority and ordinary units with arbitrary distributions
M. Jacob, S. Narmada and T. Varghese	857	Analysis of a two unit deteriorating standby system with repair
H. P. Singh and R. Singh	863	A class of shrinkage estimators for the variance of a normal population
S. Somasundaram and D. A. M. Dhas	869	Reliability of a dynamic n-unit shared load parallel system under different failure times
	873	Book reviews

Number 6

M. Meniconi, D. M. Barry and D. C. Betts	875	Variations in performance degradation of CMOS NAND gates due to ionizing radiation
A. Kleyner, S. Bhagath, M. Gasparini, J. Robinson and M. Bender	879	Bayesian techniques to reduce the sample size in automotive electronics attribute testing
C. R. Tripathy, R. N. Mahapatra and R. B. Misra	885	Reliability analysis of hypercube multicomputers
Yisong Dai	893	A precision noise measurement and analysis method used to estimate reliability of semiconductor devices

B. Burtschy, G. Albeanu, D. N. Boros, F. Popentiu and V. Nicola — 901 Improving software reliability forecasting

T. Satow and T. Nakagawa — 909 Three replacement models with two kinds of damage

I. J. Jóźwiak — 915 An introduction to the studies of reliability of systems using the Weibull proportional hazards model

Zhang Honfeng and Wang Wen Yi — 919 The NBEFR and NWEFR classes of life distributions

R. K. Paul and Md. Borhan Uddin — 923 Estimation of reliability of stress–strength model with non-identical component strengths

Research Notes

M. Jain — 929 An (m, M) machine repair problem with spares and state dependent rates: a diffusion process approach

S. A. Siddiqui, S. Jain and R. K. Chauhan — 935 Bayesian analysis of reliability and hazard rate function of a mixture model

A. Chaturvedi — 943 Further remarks on sequential estimation of a scale parameter in exponential distributions with an unknown location

S. Kumar, N. P. Mehta and D. Kumar — 949 Steady state behaviour and maintenance planning of a desulphurization system in a urea fertilizer plant

D. Pandey, S. K. Tyagi and S. Tyagi — 955 Reliability analysis of star type local area networks

C. Tripathy — 961 Microprocessor based recognition of dot-matrix characters using a fibre-optic scanner

P. Chandrasekhar and R. Natarajan — 969 Confidence limits for steady state availability of systems with lognormal operating time and inverse Gaussian repair time

973 Book reviews

977 Calls for papers

981 Calendar of forthcoming events

Number 7

SPECIAL ISSUE
RELIABILITY PHYSICS OF ADVANCED ELECTRON DEVICES

N. Stojadinović — 983 Editorial

INTRODUCTORY REVIEW

E. Takeda — 985 Challenges for giga-scale integration

HOT CARRIERS

S. Cristoloveanu — 1003 Hot-carrier degradation mechanisms in silicon-on-insulator MOSFETS

E. Simoen and C. Claeys — 1015 Hot-carrier stress effects on the amplitude of random telegraph signals in small area Si p-MOSFETS

R. Ghodsi and Y. T. Yeow — 1021 Small-signal gate-to-drain capacitance of MOSFET as a diagnostic tool for hot-carrier induced degradation

OXIDE BREAKDOWN

D. J. Dumin — 1029 Characterizing wearout, breakdown and trap generation in thin silicon oxide

E. Atanassova — 1039 Thin oxide MOS damage generated after treatment in a MERIE reactor

A. Martin, P. O'Sullivan and A. Mathewson — 1045 Study of unipolar pulsed ramp and combined ramped/constant voltage stress on MOS gate oxides

ELECTROMIGRATION

D. G. Pierce and P. G. Brusius — 1053 Electromigration: a review

J. L. Gonzalez and A. Rubio — 1073 Shape effect on electromigration in VLSI interconnects

C. Ciofi, M. Franzese and B. Neri — 1079 Characterization of Al–Si–Cu metal lines by means of TEM analysis and the SARF technique

ESD

W. R. Anderson — 1087 Circuit and process design considerations for ESD protection in advanced CMOS processes

S. Daniel, J.-W. Kim, K.-D. Hong and C.-K. Yoon — 1105 ESD tester parasitics and stress conditions and their impact on device failure levels and failure mechanisms

R. Fried, Y. Blecher and S. Friedman — 1111 Structures for ESD protection in CMOS processes

COMPOUND DEVICES

G. Meneghesso, E. De Bortoli, D. Sala and E. Zanoni — 1121 Failure mechanisms of AlGaAs/InGaAs pseudomorphic HEMT's: effects due to hot electrons and modulation of trapped charge

P. Cova, R. Menozzi, F. Fantini, M. Pavesi and G. Meneghesso — 1131 A study of hot-electron degradation effects in pseudomorphic HEMTs

V. A. Vaschenko, V. F. Sinkevitch and Y. B. Martynov — 1137 Physical limitation on drain voltage of power PM HEMT

RESEARCH NOTES

S. Dimitrijev, P. Tanner, Z.-Qiang Yao and H. B. Harrison — 1143 Slow state characterization by measurements of current–voltage characteristics of MOS capacitors

Z. Savić — 1147 A method for separating the effects of interface from border and oxide trapped charge densities in MOS transistors

1151 List of reviewers

1153 Calendar of forthcoming events

Number 8

J. Nahman — 1161 Fuzzy logic based network reliability evaluation

M. T. Madi — 1165 Bayesian inference for partially accelerated life tests using Gibbs sampling

A. M. Sultan — 1169 New approximation for parameters of normal distribution using type II-censored sampling

M. A. El-Damcese — 1173 Suggested procedure for preventive maintenance policy

J. Lee — 1179 Reliability models of a class of self-healing rings

K. Hiraoka and T. Nikaido — 1185 Reliability design of current stress in LSI interconnects using the estimation of failure rate due to electromigration

P. K. K. Loh and A. Wahab — 1193 A fault-tolerant communications switch prototype

Quey-Jen Yeh, T.-P. Chang and H.-C. Chang — 1197 An inventory control model with Gamma distribution

Quan-Lin Li, De-Ju Xu and Jinhua Cao — 1203 Reliability approximation of a Markov queueing system with server breakdown and repair

Ming-Che Lu and Dong Shang Chang	1213	Bootstrap prediction intervals for the Birnbaum–Saunders distribution
F. S. Makri and Z. M. Psillakis	1217	Bounds for reliability of k-within connected-(r,s)-out-of-(m,n) failure systems
Dequan Yue and Jinhua Cao	1225	Reliability analysis of a $M_1^{X_1}$, $M_2^{X_2}/G_1$, $G_2/1$ queueing system with a repairable service station
Su Baohe	1233	On a two-dissimilar-unit system with three modes and random check
T. Yanagisawa	1239	Estimation of the degradation of InGaN/AlGaN blue light-emitting diodes
K. Thirusangu and K. Rangarajan	1243	Marked graphs and Hamiltonian graphs
Zhi-Bin Tan	1251	Reliability and availability analysis of two-unit warm standby microcomputer systems with self-reset function and repair facility
J. Malinowski and W. Preuss	1255	Reliability of a two-way circular consecutively connected system with multistate components
S. A. Metwally	1259	Three-phase queueing servicing system with renewable servers
		Research Notes
A. Noore	1267	Fault location in multi-modular redundant systems
C. K. Goel, S. Narmada and M. Jacob	1271	Analysis of a two-unit system with connecting and disconnecting effect
	1275	World abstracts on microelectronics and reliability
	1293	Calendar of forthcoming events

Number 9

SPECIAL ISSUE
ADVANCES IN MICROELECTRONICS: APPROACHING THE MILLENIUM

A. Shah and P. Yang	1301	MOS technology: trends and challenges in the ULSI era
W.-H. Lee	1309	MOS device structure development for ULSI: low power/high speed operation
T. Ohmi and T. Shibata	1315	Intelligence implementation on silicon based on four-terminal device electronics
W. Joppich and S. Mijalković	1329	Recent advances and trends in numerical techniques for process simulation
F. Balestra and S. Cristoloveanu	1341	Special mechanisms in thin-film SOI MOSFETs
G. Ghibaudo and F. Balestra	1353	Low temperature characterization of silicon CMOS devices
I. N. Shvetzov-Shilovsky	1367	MOSFET prediction in space environments
P. Rossel, H. Tranduc and G. Charitat	1375	Power MOS devices: structure evolutions and modelling approaches
H. Tadano, M. Ishiko, S. Kawaji and Y. Taga	1389	Low loss static induction devices (transistors and thyristors)
H. L. Hartnagel	1397	Microelectronics based on compound semiconductors
R. S. Popovic and J. A. Flanagan	1401	Sensor microsystems
V. Liberali, S. Brigati, F. Francesconi and F. Maloberti	1411	Progress in high-speed and high-resolution CMOS data converters

Number 10/11

SPECIAL ISSUE

8th European Symposium on RELIABILITY OF ELECTRON DEVICES, FAILURE PHYSICS AND ANALYSIS (ESREF 97)

Editorial ix
N. Labat and A. Touboul

THEME A: BUILDING-IN QUALITY AND RELIABILITY

Diagnostic technique for projecting gate oxide reliability and device reliability 1421
J. T. Park, D. N. Ha, C. G. Yu, B. G. Park and J. D. Lee

Building-in reliability during library development: hot-carrier degradation is no longer a problem of the technologists only! 1425
R. Bellens, I. Clemminck and K. van Doorselaer

A new reliability prediction model for telecommunication hardware 1429
M. Nilsson and Ö. Hallberg

Lifetime prediction for PMOS and NMOS devices based on a degradation model for Gate-Bias-Stress 1433
A. Narr and A. Lill

Direct parameter extraction for hot-carrier reliability simulation 1437
S. Minehane, S. Healy, P. O'Sullivan, K. McCarthy, A. Mathewson and B. Mason

An on-wafer test structure to measure the effect of thermally-induced stress on silicon devices 1441
Y. Haddab, D. Manic and R. S. Popovic

Computer-based training for failure analysis 1445
C. Henderson

An other way to assess electronics part reliability 1449
P. Charpenel, P. Cavernes, J. Borowski and J. M. Chopin

THEME B: MODELLING OF FAILURE MECHANISMS

ESD

ESD characteristics of a lateral NPN protection device in epitaxial and non-epitaxial substrates 1453
T. Suzuki, S. Ito and H. Monma

Using an SCR as ESD protection without latch-up danger 1461
G. Notermans, F. Kuper and J.-M. Luchies

Improving the ESD performance of input protection circuits in retrograde well and TI structures 1457
Y.-K. Park, T.-H. Kang, C.-H. Choi, J.-T. Kong and S.-H. Lee

Dangerous parasitics of socketed CDM ESD testers 1465
H. Gossner and T. Brodbeck

Electromigration

Reliability challenges for deep submicron interconnects 1469
J. W. McPherson, H. A. Le and C. D. Graas

Are high resolution resistometric methods really useful for the early detection of electromigration damage? 1479
A. Scorzoni, S. Franceschini, R. Balboni, M. Impronta, I. de Munari and F. Fantini

The thermally balanced bridge technique (TBBT): a new high resolution resistometric measurement technique for the study of electromigration-induced early resistance changes in metal stripes 1483
J. van Olmen, W. de Ceuninck, L. de Schepper, A. Goldoni, A. Cervini and F. Fantini

Influence of ARC capping layer on stress induced voiding in narrow AlCu metallisations 1487
L. Arnaud, D. Mariolle, P. Moreau and L. Ulmer

Early resistance change and stress/electromigration modeling in aluminum interconnects 1491
V. Petrescu, A. J. Mouthaan and W. Schoenmaker

Temperature and thermal conductivity modes of scanning probe microscopy for electromigration studies 1495
A. Buck, B. K. Jones and H. M. Pollock

Oxide and MOS Devices

Dielectric reliability in deep-submicron technologies: from thin to ultrathin oxides 1499
E. Vincent, S. Buyere, C. Papadas and P. Mortini

Activation of parasitic bipolar transistor during reverse recovery of MOSFET's intrinsic diode 1507
G. Busatto, G. V. Persiano, A. G. M. Strollo and P. Spirito

Characteristics of intrinsic breakdown of thin reoxidized nitride for trench capacitors 1511
E. Wu, C. Hwang, R. Vollertsen, R. Kleinhenz and A. Strong

Analysis of the evolution of the trapped charge distributions in 10nm SiO_2 films during DC and bipolar dynamic stress 1517
R. Rodriguez, M. Nafria, J. Suñe and X. Aymerich

Oxide thickness dependence of nitridation effects on TDDB characteristics 1521
M. K. Mazumder, A. Teramoto, M. Katsumata, M. Sekine, S. Kawazu and H. Koyama

Transient stressing and transient characterization of thin tunnel oxides 1525
M. Ciappa, A. Naitana and M. Vanzi

Investigation of stress induced leakage current in CMOS structures with ultra-thin gate dielectrics 1529
C. Jahan, K. Barla and G. Ghibaudo

A high resolution method for measuring hot carrier degradation in matched transistor pairs 1533
R. Dreesen, W. de Ceuninck, L. de Schepper and G. Groeseneken

Modelling of Failure Mechanisms

Comparison of different on-chip ESD protection structures in a 0.35 μm CMOS technology 1537
C. Richier, N. Maene, G. Mabboux and R. Bellens

Gate and circuit level analysis of N-type SRAM reliability failures 1541
K. Symonds, J. Wilson, P. Lindo and M. Bahrami

A study of the thermal, electrical and mechanical influence on degradation in an aluminumpad structure 1545
X. Yu and K. Weide

Investigations of stress distributions in tungsten-filled via structures using finite element analysis 1549
J. Coughlan, S. Foley and A. Mathewson

Influence of thermal heating effect on pulsed DC electromigration 1553
P. Waltz, L. Arnaud, G. Tartavel and G. Lormand

Microstructural and surface effects on electromigration failure mechanism in Cu interconnects 1557
A. Gladkikh, M. Karpovski and A. Palevski

Effects of ESD protections on latch-up sensitivity of CMOS 4-stripe structures 1561
P. Pavan, A. Pellesi, G. Meneghesso and E. Zanoni

THEME C: TECHNIQUES AND METHODS FOR DEVICE ANALYSIS

Electron and Optical Beam Testing

Automated placement of testing pads for electron-beam observation 1565
N. Kuji and T. Takeda

Dual phase probing technique for IC-internal failure analysis 1569
S. Görlich, O. Ritschel, N. Webster and A. Winterstein

MMIC in-circuit and in-device testing with an on-wafer high frequency electric force microscope test system 1575
A. Leyk, S. van Waasen, F. J. Tegude and E. Kubalek

Absolute quantitative time resolved voltage measurements on 1 μm conducting lines of integrated circuits via electric force microscope-(EFM-) testing 1579
J. Bangert and E. Kubalek

Characterization of thermal device properties with nanometer resolution 1583
R. M. Cramer, L. Bruchhaus and L. J. Balk

High sensitivity and high resolution differential interferometer: micrometric polariscope for thermomechanical studies in microelectronics 1587
S. Dilhaire, T. Phan, E. Schaub and W. Claeys

A reliability study of titanium silicide lines using micro-Raman spectroscopy and emission microscopy 1591
I. de Wolf, D. J. Howard, M. Rasras, A. Lauwers, K. Maex, G. Groeseneken and H. E. Maes

Modification and application of an emission microscope for continous wavelength spectroscopy 1595
M. Rasras, I. de Wolf, G. Groeseneken and H. E. Maes

Noise Analysis

Low frequency noise characterization of 0.18 μm Si CMOS transistors 1599
T. Boutchacha, G. Ghibaudo, G. Guégan and T. Skotnicki

Retarding effect of surface base compensation on degration of noise characteristics of BiCMOS BJTs 1603
P. Llinares, S. Niel, G. Ghibaudo, L. Vendrame and J. A. Chroboczek

Comments on the utilization of noise measurements for the characterization of electromigration in metal lines 1607
C. Ciofi, V. Dattilo and B. Neri

Techniques and Methods for Device Analysis

Layers decoration on FIB cross-sections 1611
G. Perez, F. Courtade, B. Benteo and J. Lin-Kwan

Three-dimensional analysis for multilayer wiring in sub-half-micron devices 1615
N. Murata, Y. Hirose, K. Maekawa, M. Ikeno and H. Koyama

New methodology for localizing faults in programmable and commercial circuits 1619
R. Desplats, P. Perdu, F. Marc, Y. Danto and P. Welby

Micro-extraction spectrometers for voltage contrast in the SEM 1623
A. R. Dinnis and A. K. Dinnis

Effect of tip shape in the design of long distance electrostatic force microscopy 1627
S. Belaidi, P. Girard and G. Leveque

Applications of scanning electrical force microscopy 1631
F. Müller, A.-D. Müller, M. Hietschold and S. Kämmer

Noise and DC characteristics of power silicon diodes 1635
R. Crook and B. K. Jones

In situ ageing, a development of the *in situ* techniques for building-in reliability 1639
L. Galateanu

THEME D: III–V DEVICES

Failure mechanism and SPICE modeling of AlGaAs/GaAs HBT long-term current instability 1643
J. J. Liou and S. H. Sheu

GaAs power MMIC: a design methodology for reliability 1651
J. L. Muraro, F. Coppel, G. Gregoris, P. G. Tizien, J. L. Roux, J. Graffeuil and R. Plana

In-situ study of the degradation behaviour of GaAs MESFETS for HI-REL applications 1655
R. Petersen, W. de Ceuninck, L. de Schepper and G. Gregoris

Reliability study on three-dimensional Au/WSiN interconnections for ultra-compact MMICs 1659
H. Sugahara, M. Kimizuka, Y. K. Fukai, M. Hirano and F. Hyuga

Thermal simulation and characterisation of the reliability of THz Schottky diodes 1663
M. Brandt, M. Schüßler, E. Parmeggiani, C. I. Lin, A. Simon and H. L. Hartnagel

Finite element method applied to stress simulation of high power 980nm pump lasers 1667
M. Manna, F. Magistrali, M. Maini and D. Reichenbach

SiC-diodes forward surge current failure mechanisms: experiment and simulation 1671
A. Udal and E. Velmre

Analysis of hot electron degradations in pseudomorphic HEMTs by DCTS and LF noise characterization 1675
N. Labat, N. Saysset, A. Touboul, Y. Danto, P. Cova and F. Fantini

Development of "kink" in the output I-V characteristics of pseudomorphic HEMT's after hot-electron accelerated testing 1679
G. Meneghesso, B. Cogliati, G. Donzelli, D. Sala and E. Zanoni

Impact of InP HEMT epilayer designs on side gating effects 1683
C. Berthelemot, P. Vigier, J. M. Dumas and J. C. Harmand

An investigation into electrical parameter settling times of GaAs FETs and MMICs 1687
F. Coppel, J. M. Dumas and J. L. Cazaux

Characterisation of degradation mechanisms in resonant tunnelling diodes 1691
A. Vogt, M. Brandt, A. Sigurdardottir, M. Schüssler, D. Peña, A. Simon, H. L. Hartnagel, M. Rodewald, M. Roesner, H. Fuess, S. N. N. Goswami and K. Lal

An automatic adaptation method for heterojunction bipolar transistor dynamic test 1695
S. Gauffre, G. Duchamp, L. Casadebaig, J. Pistre and A. Cazarre

Failure mechanisms of GaAs MESFETS with Cu/refractory metallized gates 1699
T. Feng, A. Dimoulas, A. Christou, G. Constantinidis and Z. Hatsopoulos

Bias stress reliability of Be-, Zn- and C-doped base microwave HBTs 1703
A. A. Rezazadeh, T. Ahmad and M. A. Crouch

Experimental analysis and 2D simulation of AlGaAs/GaAs HBT base leakage current 1707
C. Maneux, N. Labat, N. Saysset, A. Touboul and Y. Danto

THEME E: POWER DEVICES

Cosmic ray induced failures in high power semiconductor devices 1711
H. R. Zeller

Substrate-to-base solder joint reliability in high power IGBT modules 1719
E. Herr, T. Frey, R. Schlegel, A. Stuck and R. Zehringer

Reliability issues in 650V high voltage bipolar-CMOS-DMOS integrated circuits 1723
J. A. van der Pol, H. J. Gerritsen, R. T. H. Rongen, P. P. M. C. Groeneveld, P. W. Ragay and H. A. van den Hurk

A laser beam method for evaluation of thermal time constant in smart power devices 1727
N. Seliger, D. Pogany, C. Fürböck, P. Habaš, E. Gornik and M. Stoisiek

Thermal characterization of IGBT power modules 1731
P. Cova, M. Ciappa, G. Franceschini, P. Malberti and F. Fantini

Reliability of smart power devices 1735
B. Murari

Suppressing the parasitic bipolar action of SOI-MOSFETs by using back-side bias-temperature treatment 1743
H. Koizumi, M. Shimaya and T. Tsuchiya

New understanding of LDD NMOS hot-carrier degradation and device lifetime at cryogenic temperatures 1747
J. Wang-Ratkovic, R. C. Lacoe, K. MacWilliams, M. Song, S. Brown and G. Yabiku

Effects of current density and chip temperature distribution on lifetime of high power IGBT modules in traction working conditions 1755
A. Hamidi and G. Coquery

High-temperature-reverse-bias testing of power VDMOS transistors 1759
N. Tošić, B. Pešić and N. Stojadinović

Dielectric testing for integrated power devices 1763
S. Oussalah and R. Jerisian

Bias temperature reliability of p-channel high-voltage devices 1767
A. Demesmaeker, A. Pergoot and P. de Pauw

THEME F: PACKAGING AND INTERCONNECTIONS

High performance microsystem packaging: a perspective 1771
A. D. Romig Jr, P. V. Dressendorfer and D. W. Palmer

Mechanical response of solder joints in flip-chip type structures 1783
A. Soper, G. Pozza, M. Ignat and G. Parat

Ultrasonic images interpretation improvement for microassembling technologies characterisation 1787
L. Bechou, Y. Ousten, B. Tregon, F. Marc, Y. Danto, R. Even and P. Kertesz

Micromachined structure reliability testing specificity. The Motorola MGS1100 gas sensor example 1791
J. M. Bosc and J. P. Odile

Evaluation of stresses in packaged ICs by in situ measurements with an assembly test chip and simulation 1795
C. Ducos, E. Saint Christophe, H. Frémont, G. N'Kaoua, C. Pellet and Y. Danto

Author Index I

Number 12

R. Billinton and H. Chen	1799	Weaknesses of the conventional three-state model in station-oriented reliability evaluation
E. De Baetselier, W. Goedertier and G. De Mey	1805	A survey of the thermal stability of an active heat sink
W. De Ceuninck, J. Manca, V. D'Haeger, J. Van Olmen, L. De Schepper and L. M. Stals	1813	Design of a new test structure for the study of electromigration with early resistance change measurements
R. R. Kamath and P. F. Mead	1817	Procedure for evaluation of thermal management requirements in a laser diode structure
G. A. Allan and A. J. Walton	1825	Efficient critical area measurements of IC layout applied to quality and reliability enhancement
D. J. Hauck and J. B. Keats	1835	Robustness of the exponential sequential probability ratio test (SPRT) when Weibull distributed failures are transformed using a "known" shape parameter
K. Nikawa and S. Inoue	1841	LSI failure analysis using focused laser beam heating
		Research Notes
A. J. Watkins	1849	A note on expected Fisher information for the Burr XII distribution
W. L. Pearn and K. S. Chen	1853	Capability indices for non-normal distributions with an application in electrolytic capacitor manufacturing
K.-W. Chen and A. S. Papadopoulos	1859	Shortest Bayes credibility intervals for the lognormal failure model
	1865	World abstracts on microelectronics and reliability
	1883	Calendar of forthcoming events

AUTHOR INDEX

Abdel-Ghaly A. A., 305
Abuelma'atti M. T., 609
Ahmad T., 1703
Ahmed A. M., 641
Ahmed A. N., 277
Aissani A., 267
Albeanu G., 901
Al-Dayian G. R., 305
Al-Kashkari F. H., 305
Allan G. A., 1825
Anderson W. R., 1087
Arnaud L., 1487, 1553
Arora N., 795, 819
Arsham H., 391
Atanassova E., 1039
Attia A. F., 323
Aymerich X., 1517
Aziz M. A., 809

de Baetselier E., 1805
Bahrami M., 1541
Bakkali S., 649
Balboni R., 1479
Balestra F., 1341, 1353
Balk L. J., 1583
Bangert J., 1579
Baohe S., 1233
Barla K., 1529
Barry D. M., 875
Bechou L., 1787
Belaidi S., 1627
Bellens R., 1425, 1537
Bender M., 879
Benteo B., 1611
Berthelemot C., 1683
Betts D. C., 875
Bez R., 473
Bhagath S., 879
Bhatnagar R., 753, 763
Billinton R., 1799
Blecher Y., 1111
Bonnaud O., 179
Boros D. N. 901
Borowski J., 1449
de Bortoli E., 1121
Bosc J. M., 1791
Bouhdada A., 649
Boussey J., 53
Boutchacha T., 1599
Brandt M., 1663, 1691
Brigati S., 1411
Brodbeck T., 1465
Brown S., 1747
Bruchhaus L., 1583
Brusius P. G., 1053
Bruyere S., 1499
Buck A., 1495
Burns R. J., 397
Burtschy B., 901
Busatto G., 1507

Cai J., 359
Cantarelli D., 473
Cao J., 1203, 1225
Cappelletti P., 473
Casadebaig L., 1695
Cavernes P., 1449
Cazarre A., 1695
Cazaux J. L., 1687
Cervini A., 1483
de Ceuninck W., 1483, 1533, 1655, 1813
Chandrasekar B., 829
Chandrasekaran S., 661
Chandrasekhar P., 969
Chang D. S., 1213
Chang H.-C., 1197
Chang T.-P., 1197
Charitat G., 1375
Charpenel P., 1449
Chaturvedi A., 815, 943
Chauhan R. K., 935
Chen H., 1799
Chen K. S., 1853
Chen K.-W., 1859
Cho S.-J., 725
Choi C.-H., 1461
Choi I.-K., 429
Chopin J. M., 1449
Christou A., 1699
Chroboczek J. A., 1603
Chryssaphinou O., 721
Ciappa M., 1525, 1731
Ciofi C., 77, 1079, 1607
Claeys C., 1015
Claeys W., 1587
Clemminck I., 1425
Cogliati B., 1679
Colinge J. P., 61
Constantinidis G., 1699
Coppel F., 1651, 1687
Coquery G., 1755
Coughlan J., 1549
Courtade F., 1611
Cova P., 1131, 1675, 1731
Cramer R. M., 1583
Cristoloveanu S., 1003, 1341
Crook R., 1635
Crouch M. A., 1703

Dagpunar J. S., 417
Dai Y., 893
Daniel S., 1105
Danto Y., 1619, 1675, 1707, 1787, 1795
Dattilo V., 1607
Deans N. D., 581
Demesmaeker A., 1767
Desplats R., 1619
Dey S., 673
Dhas D. A. M., 869
Dhillon B. S., 211, 505, 557
Di Pascoli S., 77
Dickson N., 121
Dilhaire S., 1587
Dimitrijev S., 1143
Dimoulas A., 1699
Dinnis A. K., 1623
Dinnis A. R., 1623
Donzelli G., 1679
van Doorselaer K., 1425
Dreesen R., 1533
Dressendorfer P. V., 1771
Drwinga R., 487
Duchamp G., 1695
Ducos C., 1795
Dumas J. M., 1683, 1687
Dumin D. J., 1029

Eichman E., 487
El-Damcese M. A., 605, 1173
El Fahham M. M., 349
El Said H. S., 349
Elhssia S. A. M., 329, 335, 493
Erhart D. L., 3
Even R., 1787

Fakinos D., 437
Fantini F., 1131, 1479, 1483, 1675, 1731
Fashandi A. R. M., 211
Feng T., 1699
Flanagan J. A., 1401
Flandre D., 61
Foley S., 1549
Franceschini G., 1731
Franceschini S., 1479
Francesconi F., 1411
Francis P., 61
Franzese M., 1079
Frémont H., 1795
Frey T., 1719
Fried R., 1111
Friedman S., 1111
Fuess H., 1691
Fukai Y. K., 1659
Fung J., 381
Fürböck C., 1727

Galateanu L., 1639
Garyet T. C., 121
Gasparini M., 879
Gauffre S., 1695
Gerritsen H. J., 1723
Ghibaudo G., 1353, 1529, 1599, 1603
Ghodsi R., 1021
Girard P., 1627
Gladden W. K., 3
Gladkikh A., 1557
Goedertier W., 1805
Goel C. K., 1271
Goel R., 845, 851
Goldoni A., 1483
Gonzalez J. L., 1073
Gopalan M. N., 587
Görlich S., 1569
Gornik E., 1727
Gossner H., 1465
Goswami S. N. N., 1691
Graas C. D., 1469
Graffeuil J., 1651
Graffi S., 95
Grégoris G., 1651, 1655
Groeneveld P. P. M. C., 1723
Groeseneken G., 1533, 1591, 1595
Guégan G., 1599
Gupta R., 845, 851
Gurov S. V., 243, 779, 801

Ha D. N., 1421
Habarov S. P., 243

Habaš P., 1727
Haddab Y., 1441
d'Haeger V., 1813
Hagin A. A., 341
Hallberg Ö., 1429
Hamidi A., 1755
Harmand J. C., 1683
Harrison H. B., 1143
Hartnagel H. L., 1397, 1663, 1691
Hatzopoulos Z., 1699
Hauck D. J., 1835
Healy S., 1437
Henderson C., 1445
Herr E., 1719
Hietschold M., 1631
Hirano M., 1659
Hiraoka K., 1185
Hirose Y., 1615
Honfeng Z., 919
Hong K.-D., 1105
Howard D. J., 1591
Hsieh Y.-C., 635
Huang H.-Z., 447
van den Hurk H. A., 1723
Hwang C., 1511
Hyuga F., 1659

Ignat M., 1783
Ikeno M., 1615
Impronta M., 1479
Inoue S., 1841
Ishiko M., 1389
Ismaeel A. A., 753, 763
Ito S., 1453

Jacob M., 857, 1271
Jahan C., 1529
Jain M., 929
Jain S., 935
Jayashree P. R., 743
Jelenkovic E. V., 159
Jerisian R., 1763
Jianping L., 237
Jones B. K., 1495, 1635
Joppich W., 1329
Jóźwiak I. J., 915

Kamarinos G., 53
Kamath R. R., 1817
Kaminska B., 785
Kämmer S., 1631
Kan C., 451
Kang T.-H., 1461
Kannan J., 665
Karpovski M., 1557
Katsumata M., 1521
Kawaji S., 1389
Kawazu S., 1521
Keats J. B., 1835
van Kemenade A. J., 87
Kertesz P., 1787
Khan M., 763
Khider S. E., 277
Kim J.-W., 1105
Kim K.-C., 725
Kimizuka M., 1659
Kleinhenz R., 1511
Kleyner A., 879
Koh J.-S., 429, 653
Kohlhase A., 19
Koizumi H., 1743
Kong F.-J., 511
Kong J.-T., 1461
Kong M. B., 467
Koutras M. V., 597
Koyama H., 1521, 1615
Krautschneider W. H., 19
Kubalek E., 1575, 1579
Kuji N., 1565
Kumar D., 795, 819, 949
Kumar S., 949
Kumar U. D., 587
Kunnari N., 487
Kuper F., 1457

Labat N., 1675, 1707
Labib S. W., 641
Lacoe R. C., 1747
Lal K., 1691
Lam Y., 497, 615
Lauwers A., 1591
Le H. A., 1469
Lee J., 1179
Lee J. D., 1421
Lee S.-H., 1461
Lee S. M., 457
Lee S.-Y., 429
Lee W.-H., 1309
Leveque G., 1627
Leyk A., 1575
Li B., 171
Li Q.-L., 1203
Liberali V., 1411
Lill A., 1433
Lim J.-H., 653
Lin C., 1663
Lindo P., 1541
Lin-Kwan J., 1611
Liou J. J., 1643
Lisenker B., 115
Litovski V. B., 137
Llinares P., 1603
Loh P. K. K., 1193
Loheac J.-L., 179
Lormand G., 1553
Lu D., 171
Lu M.-C., 1213
Luchies J.-M., 1457

Mabboux G., 1537
MacWilliams K. P., 1747
Madi M. T., 1165
Maekawa K., 1615
Maene N., 1537
Maes H. E., 1591, 1595
Maex K., 1591
Magistrali F., 1667
Mahapatra R. N., 885
Mahmoud M. A. W., 623
Maini M., 1667
Makhanov S. S., 525, 739
Makis V., 381
Makri F. S., 1217
Malberti P., 1731
Malinowski J., 255, 1255
Maloberti F., 1411
Manca J., 1813
Maneux C., 1707
Manic D., 1441
Manna M., 1667
Marc F., 1619, 1787
Mariolle D., 1487
Martin A., 1045
Martynov Y. B., 1137
Masetti G., 95
Mason B., 1437
Mathewson A., 1045, 1437, 1549
Mazumder M. K., 1521
McCarthy K., 1437
McPherson J. W., 1469
Mead P. F., 1817
Mehta N. P., 949
Meneghesso G., 1121, 1131, 1561, 1679
Meniconi M., 875
Menozzi R., 1131
Metwally S. A., 1259
de Mey G., 1805
Mijalković S., 1329
Mikulski C., 297
Milovanović D. P., 137
Minehane S., 1437
Minondo M., 53
Misra R. B., 885
Mohanavadivu P., 669, 747, 835
Mokaddis G. S., 329, 335, 493, 641
Monma H., 1453
Moreau P., 1487
Mortini P., 1499
Moshref M. E., 623
Mouthaan A. J., 1491
Müller A.-D., 1631
Müller F., 1631
Mumtaz S. Z., 845
de Munari I., 1479
Murari B., 1735
Muraro J. L., 1651
Murata N., 1615

Nafria M., 1517
Nahmad D., 473
Nahman J., 1161
Nahman J. M., 483
Naitana A., 1525
Nakagawa T., 909
Nakajima S., 39
Narmada S., 857, 1271
Narr A., 1433
Natarajan R., 969
Negley B., 487
Neri B., 1079, 1607
Nevo Y., 115
Nicola V., 901
Niel S., 1603
Nikaido T., 1185
Nikawa K., 1841
Nilsson M., 1429
Noore A., 1267
Notermans G., 1457
N'Kaoua G., 1795

Odile J. P., 1791
Ohmi T., 1315
van Olmen J., 1483, 1813
Oussalah S., 1763
Ousten Y., 1787
O'Sullivan P., 1045, 1437

Padhy N. P., 733
Palevski A., 1557
Palmer D. W., 1771
Pan J. N., 421, 439
Pandey B. N., 825
Pandey D., 955
Papadas C., 1499
Papadopoulos A. S., 1859
Papastavridis S., 721
Paranjothi S. R., 733
Parat G., 1783
Park B. G., 1421
Park D. H., 457
Park J. T., 1421
Park K. S., 467
Park Y.-K., 1461
Parmeggiani E., 1663
Paul R. K., 923
de Pauw P., 1767
Pavan P., 1561
Pavesi M., 1131
Pearn W. L., 1853
Pellesi A., 1561
Pellet C., 1795
Peña D., 1691
Perdu P., 1619
Perez G., 1611
Pergoot A., 1767
Persiano G. V., 1507
Pešić B., 1759
Petersen R., 1655
Petković P. M., 137
Petrescu V., 1491
Pham H., 187
Phan T., 1587
Philp K. W., 581
Pierce D. G., 1053
Piovaccari A., 95
Pistre J., 1695
Plana R., 1651
Pogany D., 1727
van der Pol J. A., 1723
Pollock H. M., 1495
Popentiu F., 901
Popovic R. S., 1401, 1441
Pozza G., 1783
Preuss W., 255, 1255
Psillakis Z. M., 1217
Puritis T., 713

Qambar I. S., 609

Radhakrishnan M. K., 519
Ragay P. W., 1723
Raghavachari M., 565
Rai O., 825
Rajamanickam S. P., 829
Ramachandran V., 661, 665, 733
Ramkishan, 851
Rangarajan K., 225, 1243
Raoult F., 179
Rasras M., 1591, 1595
Ravazzi L., 473
Rayapati V. N., 785
Reiche H., 555, 711
Reichenbach D., 1667
Rekha A., 677, 683
Rezazadeh A. A., 1703
Richardson D., 487
Richier C., 1537
Ritschel O., 1569
Rizvi S. A. H., 841
Robinson J., 879
Rodewald M., 1691
Rodriguez R., 1517
Roesner M., 1691
Romig Jr A. D., 1771
Rongen R. T. H., 1723
Rossel P., 1375
Roux J. L., 1651
Roy D., 361
Rubio A., 1073

Saint Christophe E., 1795
Sala D., 1121, 1679
Sarmah P., 673
Sathiyanarayanan K., 661, 665
Satow T., 909
Savić Z., 1147
Saysset N., 1675, 1707
Schaub E., 1587
de Schepper L., 1483, 1533, 1655, 1813
Schlegel R., 1719
Schneeweiss W. G., 403
Schoenmaker W., 1491
Schüssler M., 1663, 1691
Scorzoni A., 1479
Sekine M., 1521
Seliger N., 1727
Shafft H. A., 3
Shah A., 1301
Shao F.-M., 591, 629
Shawky A. I., 355
Sherif J. S., 297
Sheu S. H., 1643
Shibata T., 1315
Shimaya M., 1743
Shubinsky I. B., 779
Shvetzov-Shilovsky I. N., 1367
Shyam Sunder T., 677, 683
Siddiqui S. A., 935
Sigurdardottir A., 1691
Simoen E., 1015
Simon A., 1663, 1691
Singh H. P., 863
Singh R., 863
Singh R. K., 841
Sinkevitch V. F., 1137
Sivakumar V., 661, 665
Skotnicki T., 1599
Soliman A. A., 277
Somasundaram S., 869
Song M., 1747
Soper A., 1783
Spirito P., 1507
Sridharan V., 669, 743, 747, 835
Srinivasan A., 565
Stals L. M., 1813
Stoisiek M., 1727
Stojadinović N., 1759
Strollo A. G. M., 1507
Strong A., 1511
Stuck A., 1719
Suchatvejapoom S., 525
Sugahara H., 1659
Suich R. C., 289
Sullo P., 565
Sultan A. M., 1169
Suñe J., 1517
Suzuki T., 1453
Symonds K., 1541

Tadano H., 1389
Taga Y., 1389
Takeda E., 985
Takeda T., 39, 1565
Tan Z.-B., 1251
Tang Y. H., 315
Tanner P., 1143
Tartavel G., 1553
Taurin M., 179
Tawfek M. L., 329, 335, 493
Tegude F. J., 1575
Teramoto A., 1521
Terletzki H., 19
Thirusangu K., 225, 1243
Tizien P. G., 1651
Tong K. Y., 159
Tošić N., 1759
Touboul A., 1675, 1707
Touhami A., 649
Tran T.-L., 297
Tranduc H., 1375
Tregon B., 1787
Tripathy C., 961
Tripathy C. R., 885
Tsapelas T., 721
Tsuchiya T., 1743
Tyagi S., 955
Tyagi S. K., 955

Udal A., 1671
Uddin Md. B., 923
Ulmer L., 1487
Utkin L. V., 243, 779, 801

Vandamme L. K. J., 87
Vanderperre E. J., 525, 739
Vannakrairojn S., 739
Vanzi M., 1525
Varghese T., 857
Vaschenko V. A., 1137
Velmre E., 1671
Vendrame L., 1603
Vigier P., 1683
Vincent E., 1499
Vogt A., 1691
Vollertsen R., 1511

van Waasen S., 1575
Wahab A., 1193
Walton A. J., 1825
Waltz P., 1553
Wang H., 187
Wang M., 297
Wang W., 461
Wang-Ratkovic J., 1747
Watkins A. J., 1849
Webster N., 1569
Weide K., 1545
Welby P., 1619
Wilkie D., 487
Wilson J., 1541
Winterstein A., 1569
de Wolf I., 1591, 1595
Wu E., 1511

Wu S. L., 421
Wu Y., 359

Xishen J., 237
Xu D.-J., 1203

Yabiku G., 1747
Yanagisawa T., 549, 1239
Yang N., 505, 557
Yang P., 1301
Yao Z.-Q., 1143
Yeh Q.-J., 1197
Yeow Y. T., 1021
Yi W. W., 451, 919
Yoon C.-K., 1105
Yu C. G., 1421
Yu X., 1545
Yue D., 1225

Zanoni E., 1121, 1561, 1679
Zehringer R., 1719
Zeller H. R., 1711
Zhang H., 461
Zhao L.-C., 511, 591, 629

TYPESET IN GREAT BRITAIN BY BPC DIGITAL TECHSET LTD, EXETER. PRINTED BY BPC WHEATONS LTD, EXETER.

New and Newly Acquired Titles from Elsevier Science

Aggression & Violent Behavior
Annales Françaises D'anesthésie et Reanimation
Auris, Nasus, Larynx
Cardiovascular Research
Current Advances in Clinical Chemistry - Diskette version
Current Advances in Cell & Developmental Biology - Diskette version
Current Advances in Protein Chemistry - Diskette version
Current Advances in Toxicology - Diskette version
Current Advances in Cancer Research - Diskette version
Current Advances in Applied Microbiology & Biotechnology - Diskette version
Current Advances in Endocrinology & Metabolism - Diskette version
Current Advances in Genetics & Molecular Biology - Diskette version
Disease Management & Clinical Outcomes
Drug Discovery Today
European Journal of Cardio-Thoracic Surgery
European Journal of Agronomy
European Electronics Markets Forecast
European Journal of Pharmaceutics & Biopharmaceutics
Filtration Newsletter
Fruits
Gene-Combis
Higher Education Policy
Information Security Technical Report
Journal of International Financial Markets Institutions & Money
Journal of Multinational Financial Management
Medical Update for Psychiatrists
Mutation Research - Mutation Research Genomics
New Astronomy
Parasitology International
Pump Industry Analyst
Transportation Research Part D: Transport & Environment
Trends in Plant Science
Trends in Cognitive Sciences
Vaccine Online

CONTACT YOUR NEAREST ELSEVIER SCIENCE OFFICE FOR FURTHER INFORMATION

For customers in the Americas (North, South and Central America):
Elsevier Science,
Regional Sales Office,
Customer Support Department,
655 Ave of the Americas,
New York, NY 10010, USA
☎ Telephone: +1-212-633-3730
☎ Toll-free for customers in the USA and Canada: 1-888-437-4636 (1-888-4ES-INFO)
Fax: +1-212-633-3680
E-mail: usinfo-f@elsevier.com

Far East and Australasia (except Japan):
Elsevier Science Pte Ltd,
Regional Sales Office,
No. 1 Temasek Avenue,
#17-01 Millenia Tower,
Singapore 039192
☎ Telephone: +65-434-3727
Fax: +65-337-2230
E-mail: asiainfo@elsevier.com.sg

Japan:
Elsevier Science,
Regional Sales Office,
Customer Support Department,
9-15 Higashi-Azabu 1-chome,
Minato-ku, Tokyo, 106 Japan
☎ Telephone: +81-3-5561-5033
Fax: +81-3-5561-5047
E-mail: info@elsevier.co.jp

For customers elsewhere:
Elsevier Science,
Regional Sales Office,
Customer Support Department,
PO Box 211, 1000 AE Amsterdam,
The Netherlands
☎ Telephone: +31 20-485-3757
Fax: +31 20-485-3432
E-mail: nlinfo-f@elsevier.nl

ELSEVIER SCIENCE

CO7A05/p18

JOURNAL PACKAGES

Information on money-saving ways to buy journals such as...

Atmospheric Environment
Biochemical Pharmacology
Environmental Pollution
Life Sciences
Neuropharmacology
Neuroscience
Tetrahedron Letters
Trends in Pharmacological Sciences

Which Libraries Benefit?

Those libraries which take all the journals from a package will see an immediate benefit and saving. Libraries which take all but one of the journals may find that they can buy the missing title for a nominal amount.

What Should Libraries Do Next to Take Advantage of These Packages?

Subscription Agents have been informed about these money-saving packages and are in a position to help librarians take advantage of the savings offered. You may, of course, contact your nearest Regional Sales Office directly for more information and help.

CONTACT YOUR NEAREST ELSEVIER SCIENCE OFFICE FOR FURTHER INFORMATION

For customers in the Americas (North, South and Central America):
Elsevier Science, Regional Sales Office, Customer Support Department, 655 Ave of the Americas, New York, NY 10010, USA ☎ Telephone: +1-212-633-3730 Toll-free for customers in the USA and Canada: 1-888-437-4636 (1-888-4ES-INFO) 🖷 Fax: +1-212-633-3680 🖳 E-mail: usinfo-f@elsevier.com

Far East and Australasia (except Japan):
Elsevier Science Pte Ltd, Regional Sales Office, No. 1 Temasek Avenue, #17-01 Millenia Tower, Singapore 039192
☎ Telephone: +65-434-3727 🖷 Fax: +65-337-2230 🖳 E-mail: asiainfo@elsevier.com.sg

Japan:
Elsevier Science, Regional Sales Office, Customer Support Department, 9-15 Higashi-Azabu 1-chome, Minato-ku, Tokyo, 106 Japan ☎ Telephone: +81-3-5561-5033 🖷 Fax: +81-3-5561-5047 🖳 E-mail: info@elsevier.co.jp

For customers elsewhere:
Elsevier Science, Regional Sales Office, Customer Support Department, PO Box 211, 1000 AE Amsterdam, The Netherlands ☎ Telephone: +31 20-485-3757 🖷 Fax: +31 20-485-3432 🖳 E-mail: nlinfo-f@elsevier.nl

ELSEVIER | PERGAMON | NORTH HOLLAND | EXCERPTA MEDICA

CO7A05/p16

Did you know that if you are a contributor to any Elsevier Science Book or Journal you are entitled to

30% Discount on all our Books*?

*(except multi-volume reference works)

Contact your nearest Elsevier Science office
in order to obtain a subject catalogue

Elsevier | Pergamon | North Holland | Excerpta Medica

Elsevier Science, Regional Sales Office, Customer Support Department,
PO Box 211, 1000 AE Amsterdam, The Netherlands
• Telephone: +31 20-4853757 • Fax: +31 20-4853432 • E-mail: nlinfo-f@elsevier.nl

Elsevier Science, Regional Sales Office, Customer Support Department,
655 Ave of the Americas, New York, NY 10010, USA
• Telephone: +1-212-633-3730 • Fax: +1-212-633-3680 • E-mail: usinfo-f@elsevier.com

CO7A05/p12

Receive Regular News of Elsevier 's Publications

Elsevier Science mails information on new and existing publications regularly. If you would like to be added to the mailing list please send us your name and full mailing address, indicating your fields of interest:

ENGINEERING

Energy Sources & Technology, Civil & Structural Engineering, Mechanical Engineering, Electrical & Electronic Engineering, Systems & Control Engineering, Aeronautical & Aerospace Technology, Materials Technology, Chemical Engineering

LIFE SCIENCES & MEDICINE

Biological Sciences (including biochemistry & molecular biology), Agriculture, Immunology, Cancer Research, Pharmacology, Neuroscience, Vision Science, Clinical Medicine

PHYSICAL SCIENCES

Computer Science, Physics, Chemistry, Mathematics, Earth Science, Environmental Science, Materials Science, Space & Planetary Sciences

SOCIAL SCIENCE & HUMANITIES

Sociology, Women's Studies, Psychology, Education, Political Science, Geography, Economics, Management & Business, Linguistics, Information Science, Librarianship, Safety, Transportation

Elsevier Science
Regional Sales Office, Customer Support Department, PO Box 211,
1000 AE Amsterdam, The Netherlands
• Telephone: +31 20-4853757 • Fax: +31 20-4853432 • E-mail: nlinfo-f@elsevier.nl

Elsevier Science
Regional Sales Office, Customer Support Department,
655 Ave of the Americas, New York, NY 10010, USA
• Telephone: +1-212-633-3730 • Fax: +1-212-633-3680 • E-mail: usinfo-f@elsevier.com

CO7A05/p7